ORIGINAL RESEARCH   **REGIONAL ANESTHESIA**

Comparison of visibility and block success between Echoplex+® and Stimuplex®-Ultraline 360° echogenic needles for ultrasound-guided supraclavicular brachial plexus block for upper limb surgery

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Abstract

Background: Needle visibility is an important factor in the success of ultrasound-guided peripheral nerve block. This study aimed to compare needle visibility, block performance, time to perform block and the block success by the two echogenic needles, the Echoplex+® and the Stimuplex® Ultraline 360°, during ultrasound-guided supraclavicular brachial plexus block (SBPB).

Methodology: Seventy patients scheduled for upper limb surgery under SBPB were randomised into two groups: Group E (n = 35) was blocked using an Echoplex+® needle and Group S (n = 35) was blocked using a Stimuplex® Ultraline 360° needle. All patients received 20 ml of ropivacaine 0.75% using the same brand of ultrasound machine. The needle visibility, time to perform block and block success were recorded.

Results: Needle visibility was not found to be significantly different between the groups (p = 0.241). The medians of the time to perform block (11.0 [IQR 6] vs. 10.0 [IQR 4] min; p = 0.278) and the percentages of adequate blocks (p = 0.565) were also not found to be statistically significantly different.

Conclusion: No statistically significant differences, in terms of needle visibility, time to perform block and the block success, were found between the Echoplex+® and the Stimuplex® Ultraline 360° block needles during supraclavicular brachial plexus block. Hence, both were equally effective for the performance of the block.

Key words: Echogenic needle; Visibility; Ultrasound-guided; Supraclavicular block; Brachial plexus

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1. Introduction

Ultrasound guidance (USG) is a popular technique for peripheral nerve blocks and it has been proven to improve success and efficacy of the nerve block compared with the conventional techniques of using anatomical landmarks and nerve stimulation techniques.[1] USG

supraclavicular brachial plexus block (SBPB) is commonly performed for the upper limb surgery. Perlas et al.[2] reported a high rate of successful anesthesia and a low rate of complications in 510 consecutive patients who received SBPB from 47 different operators at different levels of training. Of the total, 94.6% of patients had
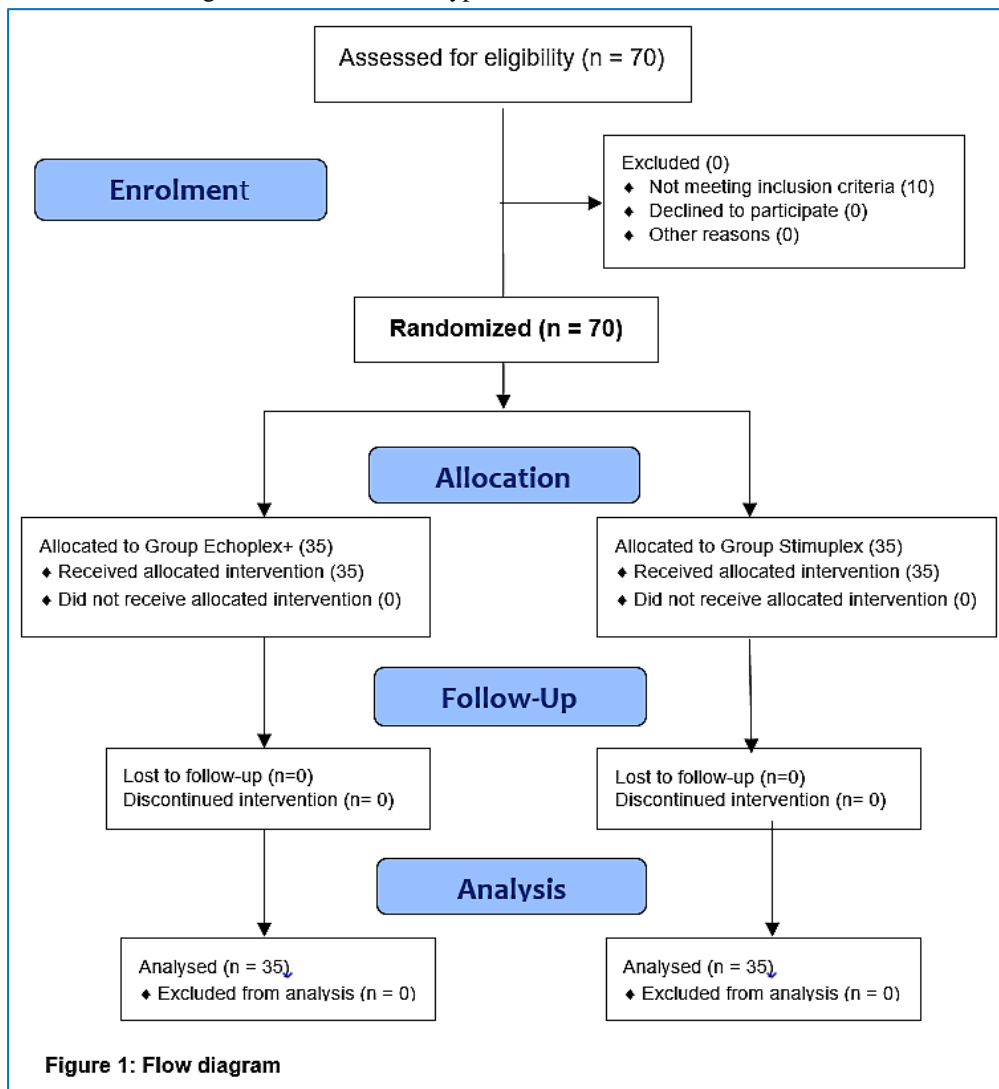
successful anesthesia after a single attempt, 2.8% required supplementary local anesthesia, and 2.6% received unplanned general anesthesia. The complication rate was low, with only a small percentage of patients with symptomatic complications. No symptomatic pneumothorax was documented.[2]

Many factors determine the success rate of USG nerve block, such as operator experience, the approach technique, the ultrasound machine technology, the type of local anesthetic regimen used and the type of needle used.[3] In the era of USG, an important factor that can improve the real-time visibility of the needle is needle echogenicity. Sviggum et al.[4] compared several echogenic needle designs by defining the characteristics of needle echogenicity and assessing 12 blinded anesthesiologists' preferences for these characteristics across various needle angles. The study concluded that all echogenic needle designs do not uniformly enhance needle visualization and that needle tip clarity most closely predicted clinician needle preferences.[4] The use of echogenic needles and catheters also reduced procedure time and the patient discomfort, compared with a stimulating catheter system.[5, 6] Echogenicity can also compensate for suboptimal scanning techniques, allow steeper angles of insertion, minimize technical difficulty and increase operators' confidence and satisfaction. The echogenic needles have been shown to be better than the conventional needles in improving operator comfort, image quality, needle visibility and needle visualization time during USG procedures in phantoms and axillary nerve blocks at insertion angles of 30–45° and ≥ 45°.[7]

As technology advances, the echogenicity of block needles is improved. This study aimed to compare the Echoplex+® needle and the Stimuplex® Ultraline 360° needle. The characteristics of the Echoplex+ needle include a 20° bevel with a specific coating for maximum echogenicity and an echogenic coating surrounding the entire needle up to the tip. The Ultraline 360° needles have a distinctive safety X-pattern with an increased number of reflective angles that enable high reflection of ultrasound waves, which can ensure good visibility. To the best of our knowledge, no previous study has compared the use of these two for peripheral nerve blocks. Therefore, we compared the two for needle visibility, time to perform block and the block success between these two needles during SBPB.

Figure 1: Flow diagram

2. Methodology

This study was a prospective, single-blinded, randomized controlled trial, conducted after ethical approval from the

Institutional Ethics Committee (approval code: USM/JEPeM: 19050282) and written consent from the patients. The inclusion criteria were patients aged 18–60 y with a body mass index (BMI) of less than 30 kg/m^2, and the exclusion criteria were allergy to local anesthetic drugs, pregnancy, past history of brachial plexus injury, underlying coagulopathy, underlying local infection at the block area and underlying neuropathy in the involved arm. Seventy patients were randomized using computer-generated randomization into two groups: Group E was blocked using the Echoplex+® needle (n = 35), and Group S was blocked using the Stimuplex® Ultraline 360° needle (n = 35) (Figure 1). The randomization sequence was concealed in an opaque envelope until opened on the morning of the surgery by the anesthesiologist in charge.

Pre-anesthetic evaluation was performed prior to the scheduled surgery, and all patients were fasted for at least six hours before the surgery. No premedication was given to the patients. Both, the patients and the assessor, were blinded to the type of needle used. The principal researcher was the single operator for the block, and the sealed envelope was opened by an anesthesiologist in–charge of the operating theatre (OT). The operator was a registrar in anesthesiology experienced in peripheral nerve blocks and especially in SBPB. All nerve blocks were conducted in the regional block bay in the OT.

Upon arrival at the regional block bay, all patients had their hemodynamic parameters recorded, including non-invasive blood pressure, heart rate, oxygen saturation and electrocardiography. Intravenous (IV) access was secured using a 20G or 18G needle on the non-operative side. All patients received supplemental oxygen 3 L/min via a nasal prong, and conscious sedation was titrated with intermittent boluses of fentanyl 25 μg and midazolam 1 mg IV, if needed. The block was conducted while the patient was in the supine position and the head was turned away contralateral to the block side. The supraclavicular area was cleaned with an aseptic technique and draped. The linear probe of an ultrasound machine (Samsung UGEO HM70A, 7-16MHz linear array high frequency transducer, South Korea) was also draped. The ultrasound probe was placed in the coronal oblique plane in the supraclavicular fossa to visualize the subclavian artery and subsequently adjusted to find the 'honeycomb' appearance of the plexus. The skin was infiltrated with 2% lignocaine using a 22G needle before introduction of the echogenic needle for the block. Group E was blocked using the Echoplex+® needle, 25G in size and 50 or 80 mm in length (Vygon, France), and Group S was blocked

Table 1: Demographic profile

Parameter	Echoplex+ (n=35)	Stimuplex (n=35)	p
Age, mean (SD), (y)	45.7 ± 14.8	41.1 ± 16.5	0.221
Height, mean (SD), (m)	1.6 ± 0.1	1.6 ± 0.1	0.733
Weight, mean (SD), (kg)	63.5 ± 8.4	63.8 ± 10.5	0.876
BMI, mean (SD), (kg/m^2)	24.7 ± 3.1	24.6 ± 3.0	0.780
Gender: n (%)			
Male	23 (65.7)	24 (68.6)	0.799
Female	12 (34.3)	11 (31.4)	
Data given as Mean ± SD, or n (%)			

using the Stimuplex® Ultraline 360 30°needle, 25G in size and 50 or 80 mm in length (B. Braun Medical Inc., Germany).

The time to perform block was recorded by the anesthesia nurse from insertion of the echogenic needle until its removal. Needle advancement was observed in real time, and it was inserted in-plane from the lateral to the medial approach towards the brachial plexus. Once the needle approached the brachial plexus bundle, the image was captured and saved in the ultrasound machine. Both groups received 20 ml of ropivacaine 0.75% (15 ml of injection at the 'corner pocket' site and another 5 ml at the 12–1 o'clock site of the brachial plexus bundle). The images were transferred and saved in the thumb drive and subsequently coded according to the randomization sequence. The thumb drive containing all 70 images was given to a blinded single assessor for grading of the needle visibility, which was assessed using a 3-point scale: 0 = no needle visibility, 1 = poor visibility and 2 = good visibility. After 30 min of performing the supraclavicular block, sensory block was assessed using a pin prick test, based upon 3-point scale for specific dermatomal distribution: 0 = sharp pain, 1 = touch sensation and 2 = no sensation. The motor block was assessed using a 4-point scale: 0 = flexion and extension against resistance, 1 = flexion and extension against gravity, 2 = flexion and extension movement in the hand but not in the arm and 3 = no movement in the entire upper limb. Block success was graded as adequate, patchy or failed. After the block, the patients were pushed to the OT for the surgery. The surgery was started if the block was adequate or, if the block was patchy, the anesthesia was supplemented with local anesthesia at a certain nerve territory or converted to general anesthesia.

The sample size was calculated using Power and Sample Size Calculations' version 3.0.10 (January 2009, © 1997–2009 by William D. Dupont and Walton D. Plummer) based on a previous study by Brookes et al.[5] that indicated the percentage of visibility in the controls (P_0) of 0.6, the percentage of visibility in the experimental group (P_1) of

0.9, the power of 0.8 and the type I error of 0.05. The sample size was 32 patients in each group, and considering a 10% drop-out (6 patients), the total sample for both groups was accepted to be 70 patients.

Data were analyzed using Statistical Package for the Social Sciences (SPSS) software version 26.0 (SPSS Inc., USA). Categorical data were analyzed with either the chi-square or Fisher's exact test, and numerical data were analyzed with either the independent t-test or the Mann–Whitney test. A p < 0.05 was considered a significant difference.

Table 2: Comparative visibility index between the groups

	Echoplex (n = 35)	Stimuplex (n = 35)	P
Needle not visible	5 (14.3)	3 (8.6)	0.241
Poor needle visibility	14 (40.0)	9 (25.7)	
Good needle visibility	16 (45.7)	23 (65.7)	

Data given as n (%)

Table 3: Time to perform the block and the success rate of block

	Echoplex (n = 35)	Stimuplex (n = 35)	P
Time to perform (min) the block, median (IQR)	11.0 (6.0)	10.0 (4.0)	0.278
Grade of successful block, n (%):			
Adequate block	31 (88.6)	31 (88.6)	0.600
Patchy Block	4 (11.4)	3 (8.6)	
Failed Block	0 (0)	1 (2.9)	

3. Results

A total of 70 patients were enrolled in this study, with 35 patients in each group. There were no significant differences in demographic data between the groups (Table 1).

Group S showed a higher percentage of good needle visibility than Group E, but the comparison was not statistically significant (65.7 % vs 45.7 %; p = 0.241; Table 2).

The difference in the median times to perform block was not significant between the two groups; e.g., 11.0 [IQR 6] vs. 10.0 [IQR4]; p = 0.278. The percentage of adequate block was identical and not significantly different between the two groups (88.6% vs. 88.6%; p = 0.565) as depicted in Table 3.

4. Discussion

Our study demonstrated no statistically significant difference in the two echogenic needles, the Echoplex+® and the Stimuplex® Ultraline 360°, in terms of visibility, time to perform block and the block success rate. To the best of our knowledge, there has been no previous comparison of these two newer brands of echogenic needles for SBPB. However, we compared our results with previous studies on echogenic needles for other USG nerve blocks.

Some studies have compared different types of echogenic needle. Nakagawa et al.[8] compared the visibility of three echogenic needles from B. Braun®, Unisis® and Hakko® with a non-echogenic needle in a phantom study, finding that the B. Braun® and Unisis® needles were more visible than the non-echogenic needle. However, the Hakko® needle's visibility was lower than that of the B. Braun® and Unisis® needles, and at 45° it had nearly the same poor visibility as the non-echogenic needle. Another study by Sviggum et al., compared the visibility characteristics of four echogenic needles and one non-echogenic needle and assessed needle preference among 12 blinded anesthesiologists.[4] The results showed that not all echogenic needles were equal in enhancing needle visualization, and the SonoPlex Stim® needle (Pajunk® Medical Systems, USA) was rated highest in four needle characteristics and overall needle rank. Nagpaul et al.[9] demonstrated that, amongst four echogenic needles, the Pajunk® Sonoplex Stim® needle was the fastest in 'needle to nerve time' to reach two nerves in the Blue Phantom® - Peripheral Nerve Block Ultrasound Training Model compared to the other echogenic needles: the Braun Stimuplex D® (22G x 50 mm), the B-Braun Stimuplex D Plus® and the D-Polymedic® needle (22G x 50 mm). Another assessment of this study showed that level of experience did not influence overall time taken with any needle.[9] Kilicaslan et al. [10] compared the performance of a USG block on a beef phantom between two echogenic needles, the Sonoplex® and the Stimuplex D Plus®, amongst 28 inexperienced users who were anesthesiology residents. The results showed that the Sonoplex® echogenic needle had significantly better tip visibility and shorter total procedure time at insertion angles between 42° and 64° than the Stimuplex D Plus®.[10]

The two echogenic needles used in our study were the latest designs from the two manufacturers, which were available at the same time in our market. Both may be

slightly different in the characteristics and design of enhancing needle visibility during USG nerve block. The Echoplex+® is a fully echogenic coated needle up to the tip of the 20° bevel, whereas the Stimuplex® 360° Ultraline® has a 360° X-pattern and clear coating with a 30° back-cut bevel. Both needles had significantly no difference in our study.

5. Limitation

The limitation of our study was the visibility of the needles being assessed from the captured image by the assessor because our initial methodology was to keep the assessor blinded from the needles. However, we believe the real-time assessment during the block intervention by manipulating of ultrasound probe is better for the actual grading of the visibility and this will be considered as an improvement of the assessment in the future research.

6. Conclusion

Both echogenic needles, the Echoplex+® and the Stimuplex® Ultraline 360°, were found to be statistically equivalent in terms of needle visibility, time to perform block and block success during supraclavicular brachial plexus block.

7. Conflict of Interest

The authors declare no conflict of interest.

8. Acknowledgement

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9. Authors' Contribution

SI, WMNWH: conception, design, execution, analysis, interpretation of the data, drafting and final approval of manuscript

MZM, LAM, CSE, RHMZ: conception, design, critical revision and final approval of manuscript

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